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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

03077059.8 ✓

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R C van Dijk

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If no title is shown please refer to the description.
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Recording methods for recording dual layer recordable disks

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Recording methods for recording dual layer recordable disks

The invention relates to recording methods for recording information on a dual layer recordable disk. The invention further relates to the corresponding recorders for recording information on dual layer recordable disks using these methods. The invention further relates to the dual layer recordable disk for use in these methods and recorders. The invention further relates to a recording method for recording information on a dual layer recordable disk in which a variable positioned OPC area is used. The invention further relates to the corresponding recorder for recording information on dual layer recordable disks using this method.

For recordable or rewritable dual-layer media, e.g. DVD+R disks or DVD+RW disks, that need to be read-compatible with read-only dual-layer disks, there is the issue of how to deal with an amount of data that requires more than one, but less than two layers.

The first recording method for recording information on a dual layer recordable disk according to the invention, method A, is depicted in the left-hand side of Fig. 1. In this method, first layer L0 is written completely full, and than the remainder of the data on layer L1 is written. The second recording method for recording information on a dual layer recordable disk according to the invention, method B, is depicted in the right-hand side of Fig. 1. In this method, the writing of the data is divided equally between L0 and L1.

Here L0 is the layer closest to the recording lens, and L1 the other one. In order to clarity this more, the layout of the dual layer DVD-ROM disk according to Standard ECMA-267 is depicted in Fig.2 for a so-called OTP (Opposite Track Path) disk. As is shown in this Standard, in an OTP disk, the spiral direction of L0 is opposite to the spiral direction of L1.

In method A, first L0 is written from R_{in} to R_{max}, which are 24mm and 58mm for DVD media. Then the laser spot jumps to L1 and the remainder of the data is written, up to a certain radius. However, in order to guarantee playback on regular DVD players, the remaining part of L1 must be written too, because some players immediately jump to the other layer if the target of a seek command is located on the other layer. And if no data is found after a layer jump, the player is very likely to crash and report a fatal error as no DPD

tracking can be performed in the absence of data written on the disk. By writing a long lead-out area as is shown in Fig.1A, compatibility with standard DVD players can be assured. However, this requires a long extra time needed to write the lead-out area ('finalization').

This problem is avoided by applying recording method B. Here the data is equally divided between L0 and L1, which implies a certain maximum radius R_{max}, beyond which no data is written on both L0 and L1.

However, another problem occurs during recording. When the spot jumps from L0 to L1, an OPC procedure has to be carried out on L1 before the recording can proceed. As is well-known to a person skilled in the art, an OPC (Optimum Power Control) procedure is a procedure for determining the actual optimum writing power for recording information on the disk. This optimum writing power depends on the disk, the recorder and the recording speed that are actually used, and therefore, this optimum writing power should be determined for each recorder/disk combination at the actual recording speed. This procedure is generally performed in an area on the disk that is specially reserved for this purpose, the OPC-area.

If this OPC area is located at the inner or outer radius of the disk, as is the case for single-layer media, first an access to that radius must be carried out. Because recording on dual-layer media is done in CLV-mode, this jump involves a change in disk rotation speed, which in general requires a considerable amount of time. During this extra time the data stream continues, which has to be captured in the memory buffer. Therefore the buffer has to be larger than in case no jump is needed. Note that the OPC is performed "on the fly" when switching from recording/reading on L0 to recording on L1. Moreover, the OPC is done at a different position than the start of the actual recording on L1, which not optimum with respect to power control. Not

More particular, performing the OPC at the outside of the disk will result in a less reliable optimum writing power as the properties of the disk at the outside (e.g. birefringence, sensitivity of the recording layers to laser power at a given wavelength) can vary.

In order to solve these problems, the method and recorder according to the invention uses an OPC-area positioned on the second layer, L1, which always close to the radius where the data stream switches from the first to the second layer.

In order to realise this fast "on-the-fly" OPC at the radius of the jump, an OPC-area is defined in the so-called Middle Zone of L1. This is indicated in Fig. 3. This Middle Zone is defined for DVD-ROM disks in the already mentioned Standard ECMA-267.

According to the standard, in dual layer DVD-ROM disks in the so-called OTP mode the Information Zone has a Middle Zone in each layer to allow the read-out beam to move from layer L0 to L1. This is shown in Fig. 4. The Middle Zone can therefore be considered as a kind of intermediate lead-out area on a dual layer disk. According to the standard, the Middle Zone extends 1mm beyond the last written address on L0. This is sufficient to incorporate an OPC-area, and very likely no harm is done if the width is taken more than 1mm. So this approach implies a variable OPC-area, the position of which depends on the amount of data on the disk. Note that it is still possible to define OPC-areas at the inner– and outer radii of the disk.

Although the invention has been elucidated with reference to the embodiments described above, it will be evident that other embodiments may be alternatively used to achieve the same object. The scope of the invention is therefore not limited to the embodiments described above, but can also be applied to all kinds of recordable and rewritable media, not limited to optical media, such as, for example, DVD+R, DVD+RW, DVD-R, DVD-RW, DVD-RAM, Blu-Ray disk. The scope of the invention is also not limited to dual layer media, but can be applied on all types of multiple layer media.

It should further be noted that use of the verb "comprises/comprising" and its conjugations in this specification, including the claims, is understood to specify the presence of stated features, integers, steps or components, but does not exclude the presence or addition of one or more other features, integers, steps, components or groups thereof. It should also be noted that the indefinite article "a" or "an" preceding an element in a claim does not exclude the presence of a plurality of such elements. Moreover, any reference sign does not limit the scope of the claims; the invention can be implemented by means of both hardware and software, and several "means" may be represented by the same item of hardware. Furthermore, the invention resides in each and every novel feature or combination of features.

CLAIMS:

1. A recording method for recording information on a dual layer recordable disk substantially as described herein before as method A.

2. A recording method for recording information on a dual layer recordable disk, the disk comprising a first layer L0 and a second layer L1, the method comprising completely recording the first layer L0, and afterwards recording the remainder of the information on the second layer L1.

3. A recording method according to claim 2, wherein, after recording, the laser spot a lead-out area is written.

4. A recorder for recording information on dual layer recordable disks using the method according to claim 1, 2 or 3.

5. A recording method for recording information on a dual layer recordable disk substantially as described herein before as method B.

6. A recording method for recording information on a dual layer recordable disk, the disk comprising a first layer L0 and a second layer L1, the method comprising dividing the information to be recorded substantially equal between the first layer L0 and the second layer L1.

7. A recorder for recording information on dual layer recordable disks using the method according to claim 5 or 6.

8. A dual layer recordable disk for use in the method according to anyone of the claims 1-7, the disk comprising OPC areas situated on both layers L0 and L1.

9. A recording method for recording information on a dual layer recordable disk using a variable OPC-area situated on the disk.

10. A recording method according to claim 9, wherein the position of the OPC-area depends on the amount of data to be recorded on the disk.

11. A recorder for recording information on dual layer recordable disks using the method according to claim 9 or 10.

12. A dual layer recordable disk for use in the method according claim 9 or 10, the disk comprising OPC areas situated on both layers L0 and L1.

ABSTRACT:

The invention relates to recording methods for recording information on a dual layer recordable disk, corresponding recorders and corresponding disks.

In a first recording method, L0 is completely written and the remainder of the data is written on layer L1. In a second recording method the writing of the data is divided equally between L0 and L1. In a third recording method an "on-the-fly" OPC is used by positioning an OPC-area on the second layer, L1 close to the radius where the data stream switches from the first to the second layer.

Fig. 2

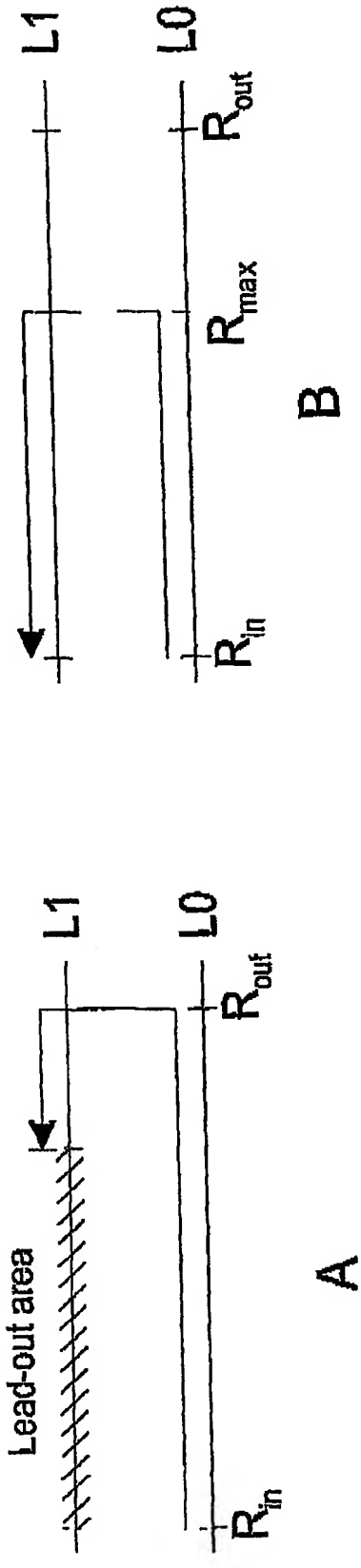

Fig.1 Recording methods A and B for dual layer discs

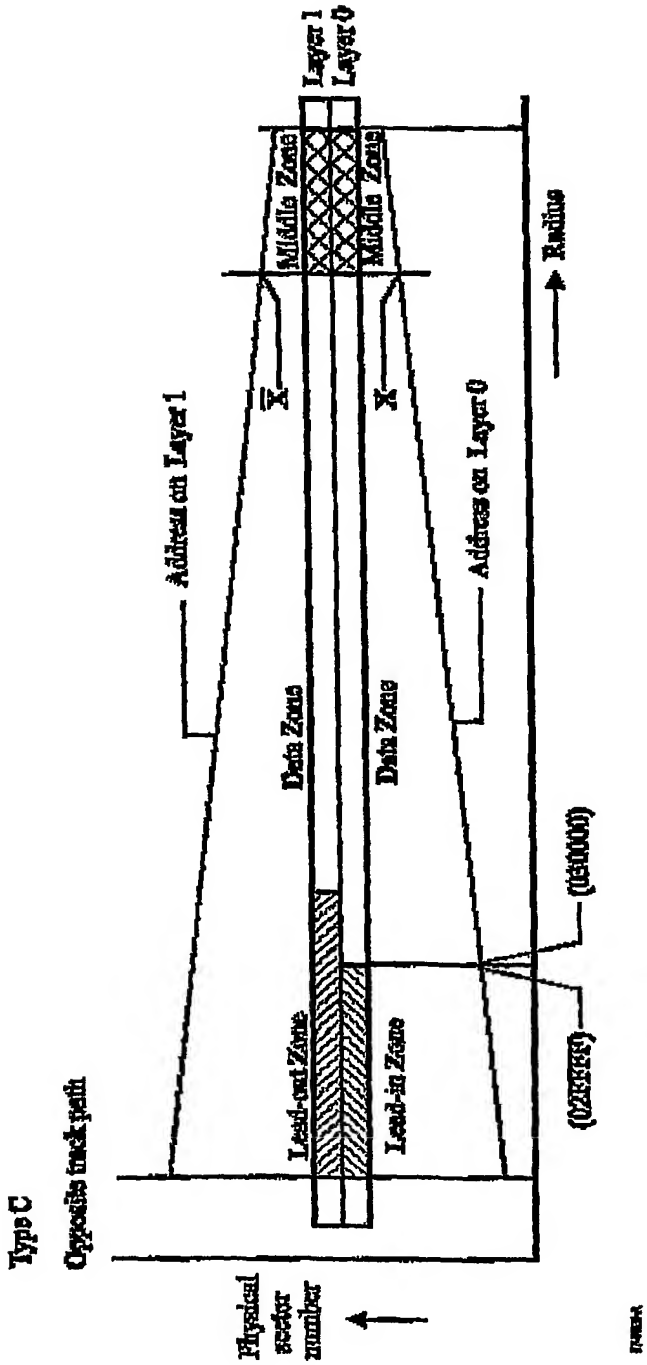

Figure 26- Physical Sector numbering on Type C in OTP mode

Fig. 2 Layout of dual layer DVD ROM disk according to ECMA-267

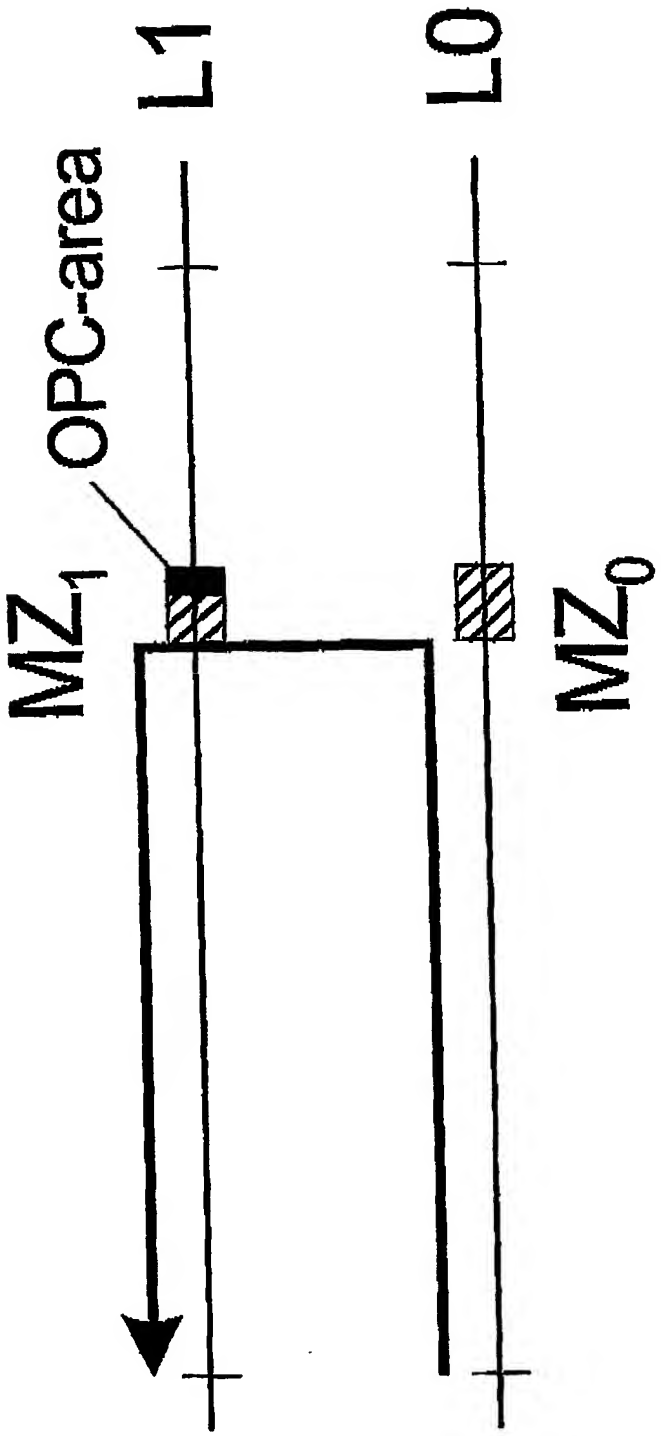

Fig. 3 OPC-area in Middle Zone of L1

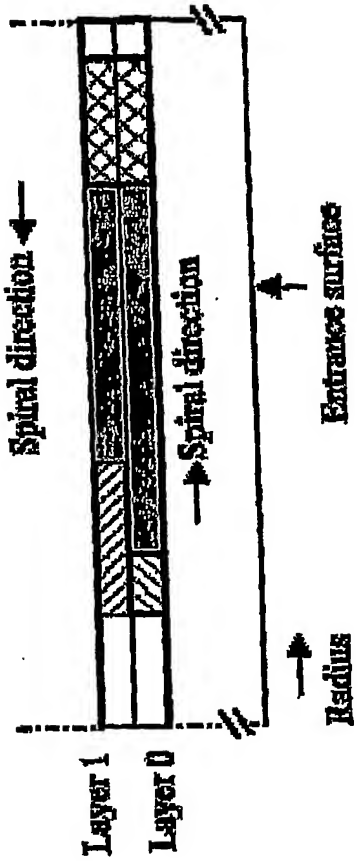

Figure 5b - Opposite Track Path (OTP)

Layer 0 = The layer closer to the entrance surface
Layer 1 = The layer farther from the entrance surface

Data Zone:
Lead-in Zone:
Middle Zone:
Lead-out Zone:

Fig. 4 Positioning of Middle Zone in OTP mode according to ECMA-267